NOTES ON HAWAIIAN LIZARDS.

By John Otterbein Snyder,
Of Stanford University, California.

During the cruise of the United States Steamer *Albatross* in 1902 and on other occasions, the writer spent some time in observing the geckos and skinks on several islands of the Hawaiian group. Notes then made relating chiefly to their habits and distribution are here recorded. There is no occasion to attempt adding to the very complete descriptions of the species presented by Doctor Stejneger[1] in his paper on Hawaiian reptiles, but an observer might profitably employ himself in a study of their habits, life history, and local distribution. The geckos especially, which may be seen almost anywhere, are very peculiar, interesting, and engaging little animals. Considerable variation is found in their anatomical structure, color, and squamation; they live under a variety of conditions, and they may be easily kept in captivity.

In collecting the geckos a large pair of forceps proved useful, and a small shot-gun served to stop the more nimble and wary skinks. Specimens were dropped at once into a small quantity of 90 per cent alcohol which contained about 2 per cent formalin. They could then be carried in the jar all day without being affected by the hot, moist atmosphere. Later they were washed for a short time in water, pierced with the scalpel, and gradually hardened in alcohol.

The little white eggs of the geckos, not unlike those of hummingbirds, never fail to attract attention. They are occasionally found after transportation to this country hidden in bunches of bananas or in the packing material of other tropical fruits. They are generally laid in any convenient place which is free from direct light, but they are not buried in the sand or moist earth like those of the skinks. The latter are elongate, pink when fresh, growing dark with the developing embryo. The shell is flexible and contains a relatively small amount of lime.

Gecko eggs are easily hatched if kept in glass-covered boxes away from direct light. As the eggs are more easily found in some places

[1] Proc. U. S. Nat. Mus., vol. 21, 1899, pp. 783–813. A brief paper by Richard C. McGregor deals with the lizards of Maui. (Proc. U. S. Nat. Mus., vol. 28, 1904, pp. 115–118.)

than the lizards themselves, ability to recognize those of the different species will aid in tracing their distribution. An interesting characteristic of the eggs of some forms is that when freshly laid the shells are soft, viscid, and flexible. They then adhere to each other, or to any foreign body which they happen to touch. They sometimes bear the appearance of having been forced with considerable pressure against some object the sides being greatly indented. On drying the shells become firm and hard, the surface retaining any impression that it may have received. The eggs of other species apparently have hard shells when laid, as they are not attached to objects, nor are their sides ever indented. Such eggs lie loose at the bottom of cavities in which they have been deposited. The period of incubation was not definitely determined. It seems short, however, as many eggs gathered July 6, some of which appeared to be quite fresh, were all hatched by August 14.

Doctor Stejneger's opinion that the lizards migrated to the islands with the ancestors of the Hawaiians is supported by observations of the habits of the geckos at least. Wherever large canoes were seen lying on the beach (a number of them were carefully examined), geckos were found concealed among the mats covering them. Eggs were found also in the canoes. It would be quite impossible at the present time to provision and launch a large canoe without including both adult geckos and their eggs.

The native name for the skink is "Moo," meaning lizard; for the gecko "Moo-kaula," a seer or magician-lizard. Some of the natives look upon the lizards with a degree of superstition, but they have no fear of them. They may be seen in the native huts and likewise in the best of houses. A number of them lived in the writer's stateroom for several months, finally arriving in San Francisco. They regularly appeared in the evening, running about the room in search of food. The climate here was apparently too cold, for they became torpid and refused to eat. They may be regarded as beneficial animals, as they destroy large numbers of insects.

Family GEKKONIDAE.

LEPIDODACTYLUS LUGUBRIS (Bibron).

Many more specimens of this species were seen than of all the others. Near Honolulu 102 examples of *L. lugubris* were noted in about two hours, while only five of other species were seen. At another time 144 specimens of *L. lugubris* were collected with only one each of the other species. The collector's catch should not be regarded as an index of the relative abundance of a species, and in this particular case it appears that the gregarious habit of the form was largely the cause of its being caught in such numbers. Geckos of a more wary nature, and those which closely resemble the bark of

trees both in the color and roughness of the skin, are apt to be overlooked. *Hemidactylus garnotii*, for example, is well protected in this way, and moreover it seems to be possessed of keen vision, is cautious of danger, and swift in flight, frequently gliding like a flash from among other geckos which remain undisturbed at the approach of danger.

Many individuals of *L. lugubris* were often found huddled together in a small crevice where they were not exposed to direct light. In such cases they might be carefully removed with the forceps, until the number was considerably reduced, when those remaining would suddenly take fright and scatter in every direction. It was not only common to find them thus assembled in favorite crannies, but they were also frequently gathered in communities. For instance, every available crack in a particular part of an old board fence was occupied, while other sections of the same fence offering accommodations which to the observer appeared equally suitable sheltered very few individuals. Moreover, when the crevices of such a community were completely depopulated, it was found that after a short time they were recolonized. One such case will serve to illustrate. One hundred and forty individuals were taken from a portion of a fence. Each crevice was carefully examined and the lizards removed, very few escaping. After a lapse of 21 days the same place was again visited and 110 specimens found. These were all adults. Other experiments proved that the same individuals did not always retire to the same place on consecutive days, and it was also seen that members of different species often pass the day together in the same little den. In one instance eggs of three forms, with embryos in about the same stage of development, were found in one place together with adult individuals of two species.

Geckos are easily caught with long forceps, the instrument being useful in extracting them from the depths of cracks. When an individual found itself pursued with the forceps it either precipitately left its retreat or darted down to the innermost corner, where it remained perfectly motionless. If further troubled it usually moved the tail forth and back, often thrashing it with some violence. In one instance an excited individual slowly backed outward from the depths of its retreat, actually presenting the wriggling tail in the direction of danger. When seized the tail parted from the body, upon which the gecko instantly crouched down and remained motionless as if expecting the accepted offering to appease the enemy. Opportunity to repeat the observation was offered, and it became quite evident that individuals of the species when driven into close quarters instinctively offer a part of their bodies that they may escape with their lives. The tails reproduce quickly, and the individual is thus soon prepared for another encounter. Nothing was learned of the enemies of the geckos.

When caught the gecko sometimes utters a faint squeak, and in running about at night it occasionally makes a shrill, cricket-like sound, not audible to all ears. Two individuals at times approach one another and touch noses with a sharp chirp. This may be observed in the house after lamplight, when the geckos scamper about over the walls and curtains.

The eggs of *L. lugubris* are pyriform in shape. The shells are white, hard, and thick, and so firm that they may be dropped from the hand to the ground without always breaking. They measure from 6.2 to 6.8 by 8.8 to 9.2 millimeters. When laid the shell is soft and viscid, but it soon hardens and adheres to whatever it touches. The shells while soft usually become indented and variously modified in form by objects with which they come in close contact. They are found sticking against vertical surfaces or cemented together in clusters, often tightly wedged in narrow cracks. They may be seen in cracks of trees, boards, and posts, under loose bark, in clumps of leaves, under rocks, behind picture frames and books, or in any place that offers partial or entire concealment. Usually two to eight eggs are in a crevice, although one cavity was seen which contained 22 eggs of *L. lugubris*, together with several of *H. garnotii*, all with embryos in various stages of development.

In about two hours after hatching the young shed a thin, papery epidermis, which peels off in scraps, leaving the fresh skin bright and delicately marked with the grays, browns, and yellows of the adults. The young are very active, and when scarcely a day old pursue flies and mosquitoes with avidity. If touched with a bristle or straw they suddenly jump, then run a short distance, wriggling their tails violently, or quickly escape and conceal themselves. They are less nocturnal than the adults and may often be seen running about when the latter are hidden away. When 10 hours' old they measure 31 to 38 millimeters in length.

In life the color varies considerably in shade, and it appears that the lighter and darker ones possess a color in keeping with their surroundings. Geckos found among the dead leaves of the banana plant were very light, with a delicate brownish, yellowish, or pink tint, unlike those of the fences or tree trunks which were dark, in some cases quite dusky. It was seen with surprise, however, that the young on emerging from eggs which had been kept for a time on white cotton exhibited about the same degree of color variation as that of the adults. Opportunity to complete a few simple experiments suggested by the above did not occur.

No differences were observed on comparing specimens from Hawaii with numerous examples from Samoa.

Collected at Honolulu: Aiea, Oahu; Waimea, Kauai.

HEMIDACTYLUS GARNOTII Duméril and Bibron.

This is the largest and most brightly colored of the Hawaiian geckos. The upper parts present a fine mosaic of grays, browns, and blacks, with prominent white spots which are arranged in somewhat irregular rows. The under parts are bright lemon yellow, the throat barely tinted, the color more intense on chest and belly, the tail inclining to orange or even salmon red; ventral parts of legs yellow.

Individuals of the species appear to be solitary in habit, at least not gregarious like *L. lugubris*. One passes the day concealed in some crevice, from which it may be seen peering out, or it may be lying flat on the shady side of a limb conveniently near an opening in the bark. On an observer's approach it darts within, not always concealing itself. If not further disturbed it soon turns about and cautiously looks out. If a capture is attempted it either disappears within its retreat or instantly springs out and makes for another crevice, or scrambles nimbly up the tree on the side opposite the enemy. If closely pursued it may suddenly drop to the ground, where it lies sprawled out and perfectly motionless. When driven into a corner it turns about, opens its mouth, and thrusts out its tongue, which is moved along the lips in a characteristic way. It will bite one's finger, holding on tenaciously, although not able to produce the slightest wound.

The eggs are white, almost spherical, measuring 9 to 10 by 10 to 11 millimeters in diameter. The shells are smooth and firm, apparently neither soft nor sticky when laid. They are deposited loosely in crevices, often among eggs of *L. lugubris*. Four or five may occasionally be found in the same place.

The newly hatched young vary considerably in size, specimens about 10 hours old measuring 39.5 to 56 millimeters in length, the slender tail adding much to the elongate form. They are very active, snapping up small insects and occasionally springing upon flies almost too large for them to manage. When pursued with one's finger or a pencil they rush about in a panic, thrashing their tails from side to side. An egg, accidentally dropped and broken, freed a young gecko, which immediately disappeared to new cover, leaving the tail wriggling among the pieces of shell. The young are able to utter a scarcely audible squeak. On hatching, the skin is moist, but it soon dries and becomes silvery in color. Small areas of the epidermis loosen, puff out from the body, and eventually tear and break away, so that in from one to two hours the new skin appears bright and shining. The dorsal surface lacks the white spots of the adult; the under parts are light yellow or orange, deepening on the tail to orange or salmon red.

Honolulu; Aiea, Oahu; Puako Bay, Hawaii; Lahina and Wailuku River, Maui; Waimea, Kauai. Eggs of the species were found on Laysan Island.

PEROPUS MUTILATUS (Wiegmann).

The skin of this species is so thin and tender that a specimen may scarcely be caught without mutilating it. The struggles of the animal in one's fingers result in tearing great rents in the skin, and it is difficult to retain one between the tips of the forceps. The wounds thus made bleed but very little, and it appears that the fragile skin, like the easily broken tail, aids the animal at times in escaping from an enemy.

In life the under parts are more or less tinted with yellow, very bright in some examples, almost absent in others. The color is more intense on the hind legs and belly.

Eggs of the species, easily distinguished from the others, were secured and successfully hatched. Specimens of both the eggs and young were lost in transportation, and no description remains.

Honolulu; Waimea, Kauai; Puako Bay, Hawaii.

HEMIPHYLLODACTYLUS LEUCOSTICTUS Stejneger.

In life the whole body is slightly tinted with pink. The under parts from the throat posteriorly, including the legs, are pale yellow. In the younger specimens the tail is pale orange beneath. Where the tail has been reproduced, the yellow color stops short, the lately acquired part being dark beneath. The throat is spotted with dusky.

Eggs measuring 5.7 to 6.6 millimeters, smaller than those of other species, found under a bit of loose bark, proved on hatching to belong to this species. They were slightly indented and firmly cemented together. The young, just hatched, measured 29 millimeters in length; snout to tail, 15.5. They soon shed the epidermis, exhibiting the colors of the adult. They are precocious like the young of other forms.

Honolulu; Waimea, Kauai.

Family SCINCIDAE.

LEIOLOPISMA NOCTUA (Lesson).

One specimen was seen at Honolulu.

EMOIA CYANURA (Lesson).

Specimens collected by the writer exhibit two types of coloration [1] one with a well-defined, narrow, light band extending from the posterior edge of the rostral plate to at least the middle of the body; the other without a distinct median band, which if at all developed never extends on the head.

[1] Stejneger (Proc. U. S. Nat. Mus., vol. 21, 1899, p. 808) discusses the color variation of this species, and Werner (Zool. Jahrb. Syst., vol. 14, p. 384) describes some dark-colored examples from Molokai as *Lygosoma cyanurum schauinslandi*. The figure in Zoology of the Voyage of the *Coquille* (pl. 4, fig. 2) is of interest in this connection.

Examples from Waimea, Kauai, belong to the first type. In some of these a median band which covers the adjoining halves of two rows of scales is sharply outlined to the base of the tail, while in others it grows indistinct and blends with the lateral bands near the middle of the body. The lateral bands vary, as does the median one, occasionally fusing with the latter not far behind the shoulders, but always remaining distinct on the head and neck. There is no light band on the side, extending between the front and hind legs. In life the light bands are brassy, and many scales on the sides have a metallic sheen. The tail is not blue, but becomes so on immersion in alcohol.

The second type is represented by specimens from Hanalei Valley, Kauai, and from Wailuku Valley, Maui. In one individual three light bands are present. The median one, which covers two rows of scales, is well separated from the others, and extends from the occiput to near the base of the tail. Lateral bands extend from the eye to the same point posteriorly. In others the bands are more or less completely fused, forming a broad, light-colored area. All agree in being much darker, both on the dorsal and ventral surfaces, than those of the first type, the brassy bands being much duller and contrasting less strongly with the darker portions. In these also the bands have a metallic sheen in life and the tails are not blue.

An examination of this material seems to show that the color variation is not due to age or sex. It is worth mentioning that those of the first type were found in a relatively dry region where lantana and prickley pears flourish, while the others were taken at a high altitude from the moist ground beneath masses of ferns, in dense thickets of tropical vegetation.

Waimea and Hanalei Valley, Kauai; Wailuku River, Maui.

ABLEPHARUS POECILOPLEURUS (Wiegmann).

Unlike *Emoia cyanura*, this species appears to be confined to the dryer regions of low altitudes, and is not seen in the moist valleys of the mountains.

Of 10 adult specimens found on Laysan Island none possessed a perfect tail. They had suffered amputations at various times, one individual having a third growth. Lizards' tails are not mentioned in papers dealing with the food of birds, the probable enemies of Laysan skinks.

Puako Bay and Waimea, Hawaii; Laysan Island.